Citation:

Boon N, Koppes Ll, Saris WH, Van Mechelen W. The relationship between calcium intake and body composition in a Dutch population: The Amersterdam Growyj and Health Longitudinal Study. Am J Epidemiol. 20005 Jul 1; (1): 27-32.

PubMed ID: 15961583

Study Design:

Prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate whether dietary calcium intake is related to body mass index and the sum of four skinfolds among subjects in the Amsterdam Growth and Health Longitudinal Study (the Netherlands), and whether fiber, energy intake, and physical activity confound this relation.

Inclusion Criteria:

Cohort of men and women from age 13 years in 1977 to age 36 years in 2000.

In 1977, boys and girls whose mean age was 13(standard deviation, 0.7) years and who attended a secondary school in the Netherlands-more than 95% Caucasian-were assessed regarding a wide variety of characteristics including dietary calcium intake and body composition.

Exclusion Criteria:

Exclusion criteria was not delineated.

Description of Study Protocol:

Recruitment

Subjects were participants of the Amersterdam Growth and Health Longitudinal Study in the Netherlands.

Design

Prospective cohort study design

Blinding used (if applicable)

Intervention (if applicable)

Statistical Analysis

- Longitudinal linear regression analyses were performed with generalized estimating equations in continuous and categorical models, with adjustment for possible confounders.
- Generalized estimating equations were performed by using the Statistical Package for Interactive Data Analysis.

Data Collection Summary:

Timing of Measurements

- Three measurements on the same subjects followed annually from 1978 through 1980.
- Additional follow-up measurements were performed in 1985,1991,1996, and 2000 when the subjects were an average age of 21,27,32, and 36 years, respectively.
- An equally large and same-aged cohort from another secondary school was assessed only once in the first 4 years of the study and was reassessed in 1996 and 2000 only.
- This difference between the two schools explains the increased number of participants for the follow-up measurements at ages 32 and 36.
- In total, 296 men and 333 women participated in the study.
- The method used to measure dietary calcium intake and body composition remained the same over the 23 years of the follow-up.

Calcium intake:

- The dietary interview provided information about subjects' habitual dietary intake by using the 4 weeks preceding the interview as a reference.
- A traditional, face-to-face dietary intake interview was conducted during the first seven measurements, whereas, during the last measurement in 2000, a computer-assisted method was used.

Dependent Variables

Body composition

- Anthropometric measurements of body height, body mass, and four skinfolds (biceps, triceps, and subscapular and cresta iliaca) were performed according to standard procedures.
- Body mass index (BMI), the quotient between body mass (in kilograms) and body height (in meters squared), was used as an indirect measure of fat mass.
- The sum of four skinfolds (S4S) (biceps, triceps, subscapular and iliac crest) was used as a more direct measure of fat mass.

Independent Variables

Calcium Intake:

- An extensive cross-check dietary history interview was used to assess dietary calcium intake.
- The interview consisted of 2 parts. The first was focused drawing a pattern of the subjects' eating habits and meal patterns; in the second, an extensive checklist was used to give a more detailed description of all foods and drink items consumed.
- "Cross-check" means that an additional check was performed on the reported frequency of the meals eaten and on eating habits during the first part and the food and drink items mentioned in the second part of the interview.
- The computer-assisted method was added during the measurements to reduce interview time and inter-interview variability.
- This computer-assisted cross–check dietary history interview has been validated against the traditional food history and against the 3-day weighed food record and 24 hour dietary recall methods.
- From this interview, mean daily intake of various nutritional factors was calculated by using the Dutch Food and Nutrition Table.

Control Variables

- Age
- Sex

Description of Actual Data Sample:

Initial N: 296 men and 333 women

Attrition (final N): 296 men and 333 women

Age: See Table 1

Ethnicity: 95% Caucasian

Other relevant demographics:

Anthropometrics (e.g., were groups same or different on important measures)

Location: The Netherlands

Summary of Results:

Key Findings

- Results showed that calcium intake during adolescence was a weak predictor of calcium intake in childhood.
- In this population, only a slight indication was found of a weak inverse relation of calcium intake with body composition.
- In men, the age-adjusted model, a 1,000 mg per day higher dietary calcium intake was related to a 0.21 cm lower sum of skinfolds (P=0.004). In the age-adjusted model for women, the highest dietary calcium intake group (>1,200 mg/day) had a significantly lower sum of skinfolds than those consuming less than 800 mg of calcium per day (P=0.04).
    - these associations disappeared after adjustment for putative confounders
- No differences were observed between the middle (800-1200mg/day) and high (>1200 mg/day) groups of calcium intake, suggesting a threshold of approximately 800 mg/day above which calcium intake had no additional beneficial effect on body composition.

Table 1. Means(standard deviations) of dietary calcium intake, body mass index, and the sum of four skinfolds* at the eight follow-up measurements of men and women followed from age 13 to 36 years in the Amsterdam Growth and Health Longitudinal Study, the Netherlands, 1977-2000.

			Dietary calcium intake (mg/day)		Body mass index (kg/m ^{2})		Sum of four skinfolds (cm)	
Age (years)	Men (no.)	Women (no.)						
			Men	Women	Men	Women	Men	Women
13	187	204	1,122(408)	991(396)	17.6(1.7)	18.5(2.2)	2.8(1.2)	3.8(1.4)
14	146	170	1,140(461)	988(412)	18.2(1.8)	19.2(2.3)	2.7(1.0)	4.3(1.6)
15	150	170	1,218(491)	921(382)	18.9(1.9)	19.6(2.2)	2.7(0.9)	4.7(1.6)
16	132	173	1,198(467)	929(388)	19.2(1.9)	20.1(2.3)	2.7(0.9)	4.9(1.6)
21	93	107	1,325(562)	1,055(446)	21.4(2.0)	21.6(2.7)	3.6(1.4)	5.4(1.9)
27	84	97	1,363(549)	1,159(418)	22.5(2.2)	21.9(2.5)	3.6(1.4)	4.6(1.6)
32	203	230	1,372(616)	1,195(411)	24.0(2.6)	22.7(3.0)	4.2(1.7)	5.2(2.0)
36	174	198	1,435(606)	1,264(418)	24.8(2.7)	23.4(3.3)	4.7(1.5)	5.5(1.9)

* Biceps, triceps, and subscapular and cresta iliaca.

Table 2. Linear regression coefficients and 95% confidence intervals for the longitudinal association of dietary calcium intake(per 1,000 mg/day) with body mass index and the sum of four skinfolds† in men and women followed from age 13 to 36 years in Amsterdam Growth and Health Longitudinal Survey Study, the Netherlands, 1977-2000.

	Adjusted for age		Adjusted for multiple factors ‡	
	ß	95% CI§	ß	95% CI

Body mass index				
Men	0.07**	-0.22,0.36	-0.06**	-0.35, 0.23
Women	-0.04	-0.37,0.29	0.20	-0.17,0.58
Sum of four skinfolds				
Men	-0.21****	-0.35, -0.06	-0.09*	-0.24, 0.07
Women	-0.17	-0.41, 0.07	0.11	-0.17, 0.40

*Negative interaction with age, p<0.05; **negative interaction with age, p<0.01;
*** significant at p<0.01.
†Biceps, triceps, and subscapular and cresta iliaca.
‡Regression coefficients were adjusted for age, dietary energy intake, fiber intake, and habitual physical activity.
§ CI, confidence interval

Table 3. Linear regression coefficients and 95% confidence intervals for the longitudinal association of dietary calcium intake(3 categories) with body mass index and the sum of four skinfolds† in men and women followed from age 13 to 36 years in Amsterdam Growth and Health Longitudinal Survey Study, the Netherlands, 1977-2000.

Dietary calcium intake category(mg/day)	Adjusted for age		Adjusted for multiple factors ‡	
	ß	95% CI§	ß	95% CI
Body mass index				
Men				
<800	Reference		Reference	
800-1,200	-0.14	-0.44, 0.15	-0.20	-0.49,0.09
>1200	0.03*	-0.38, 0.44	-0.07*	-0.60,0.29
Women				
<800	Reference		Reference	
800-1,200	-0.18	-0.43,0.08	-0.02	-0.29,.0.24
>1200	0.26	-0.62, 0.10	0.02	-0.35,0.40
Sum of four skinfolds				
Men				
<800	Reference		Reference	
800-1,200	-0.08	-0.25,0.10	-0.01	-0.20,0.17
>1200	-0.09*	-0.29, 0.12	0.09*	-0.13,0.31
Women				
<800	Reference		Reference	
800-1,200	-0.15	-0.34,0.05	-0.00	-0.19,0.19
>1200	-0.28**	-0.56, -0.01	0.04	-0.26, 0.34

*Negative interaction with age, p<0.01; ** significant at p<0.05.
†Biceps, triceps, and subscapular and cresta iliaca.
‡Regression coefficients were adjusted for age, dietary energy intake, fiber intake, and habitual physical activity.
§ CI, confidence interval

Author Conclusion:

- The results of this investigation of relatively healthy subjects followed from age 13 to 36 years indicate a weak inverse relationship of calcium intake with body composition.
- There may be a threshold for calcium intake above which no additive beneficial effect exists. In this present investigation, the calcium intake threshold was about 800 mg per day.

Reviewer Comments:

Limitations:

- *The researchers were not able to correct for the possible confounding effects of a higher protein intake*

because of the high covariance between protein and calcium intake in this cohort.

- *Underreporting of food intake by obese subjects is well established. This problem may have caused a type I error because it could have led to underestimation of calcium intake among subjects with higher BMI and S4S.*
- *Indirectly measuring food could have resulted in a large amount of error in the calcium data and consequently may have caused type II errors. The relative absence of significant inverse findings may also be explained by the fact that a dietary history interview was used, whereas most epidemiological investigation referenced in the study used food diaries to measure food intake.*
- *Their tracking system analyses showed that dietary calcium intake had a low stability over time. This finding indicated that calcium intake during adolescence is a weak predictor of calcium intake later in life.*

Analytical longitudinal surveys refer to what epidemiologists term prospective or cohort studies. A Cohort Study is a study in which patients who presently have a certain condition and/or receive a particular treatment are followed over time and compared with another group who are not affected by the condition under investigation. Studies of this kind provide a better opportunity than one time cross sectional studies to examine whether certain behaviors do in fact lead to (or cause) the disease.

The limitations and critique of the study, as stated by the authors appear to be very appropriate.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes

3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	N/A
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	N/A
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes

6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes